

UNITED STATES PATENT APPLICATION

FOR

PALLET DISPENSER

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## **DESCRIPTION OF THE INVENTION**

[001] This application claims priority under 35 U.S.C. § 119 based on U.S. Provisional Application Number 60/422,514, filed October 31, 2002, the entire disclosure which is incorporated herein by reference.

### **Field of the Invention**

[002] This invention relates to a pallet dispenser. More particularly, this invention relates to a pallet dispenser for dispensing pallets to a palletizer that builds loads on a pallet.

### **Background of the Invention**

[003] Manufacturing and delivery industries often load pallets with products for ease of handling and delivery. Typically, a manufacturing facility keeps a large number of pallets on hand to be used for this handling and delivery. Pallet dispensers are often used to store the pallets prior to their use. Pallet dispensers feed empty pallets to palletizers for load building, and in some cases, to wrapping systems for subsequent wrapping of the pallet load.

[004] Pallet dispensers typically operate by vertically separating the lowermost pallet in a stack from the remainder of the stack of pallets, and conveying the lowermost pallet from the bottom of the stack. This vertical separation eliminates any friction between the lowermost pallet and the remainder of the stack. One type of a pallet dispenser inserts a securing device, such as forks, pinwheels, or clamps, into the pallet located directly above the lowermost pallet. The securing device is

then used to raise the stack of pallets off of the lowermost pallet. Finally, the lowermost pallet is dispensed out from underneath the stack of pallets.

[005] Another type of a pallet dispenser inserts forks or other securing devices into the pallet directly above the lowermost pallet. However, instead of raising the stack of pallets off of the lowermost pallet, as explained above, the stack of pallets is suspended in place, while the lowermost pallet is lowered away from the stack of pallets. The lowermost pallet is then conveyed from the pallet dispenser. Vertically separating the lowermost pallet from the stack of pallets eliminates the resistance and friction between the stack and the lowermost pallet.

[006] In order to dispense pallets of varying thickness, or pallets of different dimensions, the above-described dispensers require mechanical adjustment. If the thickness of the pallets within a given stack varies, the height of the forks, pinwheels or clamps must be adjusted to align them with the pallet directly above the lowermost pallet. If the dimensions of the pallets vary, the dispensers must be adjusted so that the forks or securing devices still extend into the pallets. Accordingly, when frequent changeover in pallet size is required, the dispensers have downtime, decreasing efficiency in the loading of product.

[007] Another type of pallet dispenser uses an endless conveyor to push a pallet from the bottom of the stack of pallets. One drawback to this type of system is that driving mechanisms are required beneath the stack of pallets, thereby requiring the pallet dispenser to be elevated above the ground. This reduces accessibility to the dispenser when the dispenser is loaded by hand, which may result in fewer pallets being loaded at any one time.

[008] Another drawback to prior art pallet dispensers is that they may be expensive to build, and therefore purchase. Because of this, smaller manufactures may determine that pallet dispensing systems are cost-prohibitive, and instead opt to not use dispensers at all. Further, because of their complex nature, the above described dispensers may be costly and difficult to maintain.

### **SUMMARY OF THE INVENTION**

[009] The present invention is directed to pallet dispensers and methods for dispensing a pallet from a pallet dispenser that provides advantages and obviates a number of problems in earlier dispensers and methods.

[010] According to one aspect, the invention is directed to a pallet dispenser for stripping a lowermost pallet from a vertical stack of at least two pallets. It includes a pallet magazine for storing the vertical stack of pallets, and a platform disposed below the pallet magazine. The platform may be configured to support the vertical stack of pallets.

[011] In another aspect, a cantilevered pusher bar may be configured to push the lowermost pallet from under the vertical stack of pallets and out of the pallet magazine. In another aspect, the pallet magazine may include a front gap sized to allow passage of the lowermost pallet. It may also include a rear gap sized to allow passage of the pusher bar. The pusher bar may be movable between a substantially vertical position and a substantially horizontal position. When in the substantially horizontal position, the cantilevered pusher bar may be movable through the rear gap of the magazine to the front gap. The cantilevered pusher bar may be configured to move, while in a resetting position, from a position adjacent a

front of the magazine to a position adjacent a rear of the magazine, and may be in a substantially vertical position.

[012] In another aspect, rotating means for rotating the pusher bar about an axis to move the pusher bar between a dispensing position and a resetting position may be included. The rotating means may be a motor operably associated with the pusher bar, for rotating the pusher bar.

[013] In another aspect, the platform may include a smooth metal plate or may include non-driven rollers. The dispenser may also include means for adjusting the size of an interior of the pallet magazine.

[014] In one aspect, a pusher carrier may be rotatably attached to the pusher bar and a pusher guide may be configured to guide movement of the pusher carrier. A palletizer may be disposed adjacent the pallet dispenser. The pusher bar may be configured to push the pallet from the pallet magazine to the palletizer.

[015] In yet another aspect, motion means may provide motion to the vertical stack of pallets in the magazine. It may include at least a portion of the platform. A sensor may be associated with the pusher bar, and may be adapted to determine a jam condition of the lowermost pallet. A controller may activate the motion means when the sensor determines the jam condition. The motion means may include a motion bar extending through at least a portion of the platform, and a motor for moving the motion bar. It may further include a motion shaft eccentrically attached to an output shaft of the motor. The motion shaft also may be attached to the motion bar, such that the motion shaft drives the motion bar to provide motion to

the stack of pallets. The motion bar may include rollers mounted thereon. In another aspect, the pallet magazine is cantilevered.

[016] In another aspect, it includes dispensing means for moving the lowermost pallet from a bottom of the vertical stack and out of the pallet magazine, and motion means for providing motion to the stack of pallets. The motion means may be operably associated with at least a portion of the platform. It may include a motion bar extending through at least a portion of the platform.

[017] In another aspect, a pusher bar configured to push a lowermost pallet from under the vertical stack of pallets and out of the pallet magazine, wherein the pusher bar also is configured to at least partially support the weight of the pallets on the lowermost pallet to reduce the friction between the lowermost pallet and the adjacent pallet in the vertical stack of pallets.

[018] In one aspect, the pusher bar may include a roller configured to contact the pallet directly above the lowermost pallet in the vertical stack of pallets. It may also include a tapered portion. A bottom of the tapered portion may be configured to have a height lower than a top of the lowermost pallet, and a top of the tapered portion may be configured to have a height above the top of the lowermost pallet. The tapered portion may be configured to lift the vertical stack of pallets off the lowermost pallet. In another aspect, the pusher bar may be configured to transfer at least a part of the weight of the stack of pallets from off the lowermost pallet to the pusher bar.

[019] In another aspect, the roller supports the weight of the pallet stack. A wheel may be included on the pusher bar and may support weight of the pusher bar

and weight of the pallets supported by the pusher arm. The wheel may be disposed at one end of the pusher bar. A track through the pallet magazine may be configured to support the wheel.

[020] In another aspect, the pusher bar includes an angled portion and a roller adjacent a top of the angled portion. In yet another aspect, a base may support the vertical stack of pallets. It may include rollers.

[021] In another aspect of the invention, a method of dispensing a lowermost pallet from a vertical stack of pallets is provided. It includes placing a stack of pallets in a pallet magazine and supporting the stack of pallets on a platform of the magazine. It also includes pushing a lowermost pallet of the stack of pallets with a cantilevered pusher bar to strip the lowermost pallet from the stack. In one aspect, it includes loosening the lowermost pallet from the stack of pallets.

[022] In another aspect, motion is provided to the stack of pallets to reduce the friction between a lowermost pallet of the stack and the remainder of the stack of pallets, and the lowermost pallet is dispensed from the pallet magazine.

[023] In yet another aspect, the invention is directed to an apparatus for building and wrapping a load. It may include a pallet dispenser and means for building a load on the dispensed pallet. It may also include a packaging material dispenser and means for providing relative rotation between the packaging material dispenser and the load to wrap packaging material around the load.

[024] In one aspect, the means for building a load is a palletizer. The means for providing relative rotation may be a turntable, and the means for providing relative rotation is a rotating arm.

[025] In another aspect, the invention is directed to a palletizing system. It may include a pallet dispenser and a palletizer disposed adjacent the pallet dispenser. The pusher bar may be configured to push a pallet of the stack of pallets from the pallet magazine to the palletizer. The means for loosening may be a motion assembly configured to provide vibratory motion.

[026] In yet another aspect, a method for building and wrapping a load is disclosed. It includes pushing a lowermost pallet of the stacked pallets with a cantilevered pusher bar to strip the lowermost pallet from the stack of pallets. It also includes building a load on the dispensed pallet and providing relative rotation between a packaging material dispenser and the load to wrap packaging material around the load. It may also include loosening the stack of pallets while pushing the lowermost pallet with the cantilevered pusher arm.

[027] In yet another aspect, the invention is directed to an apparatus for dispensing a lowermost pallet from a vertical stack of pallets. It may include a pallet dispenser including a pallet magazine for holding the stack of pallets, and a platform below the pallet magazine and motion assembly means associated with the platform of the pallet dispenser for reducing friction between a lowermost pallet and the stack of pallets.

[028] In yet another aspect, a method of dispensing a lowermost pallet from a vertical stack of at least two pallets may include lifting the stacked pallets above the lowermost pallet with the pusher bar to reduce the friction between the lowermost pallet and the pallets above it. In another aspect, the method may include transferring at least a part of the weight of the stacked pallets on the



lowermost pallet to the pusher bar to reduce the friction between the lowermost pallet and the pallet above it.

[029] In another aspect, the method may include contacting the pallet directly above the lowermost pallet in the vertical stack of pallets with a roller on the pusher bar.

[030] Additional objects and advantages of the invention will be set forth in part in the description which follows, and in part will be obvious from the description, or may be learned by practice of the invention. The advantages of the invention will be realized and attained by means of the elements and combinations particularly pointed out in the appended claims.

[031] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the invention, as claimed.

### **BRIEF DESCRIPTION OF THE DRAWINGS**

[032] The foregoing and other features and advantages of the invention will be apparent from the following more particular description of the invention, as illustrated in the accompanying drawings.

[033] FIG. 1 is a pictorial representation showing an isometric view of a load building and wrapping system incorporating a pallet dispenser according to an aspect of the present invention.

[034] FIG. 2 is a pictorial representation showing an isometric view of a pallet dispenser according to an aspect of the present invention.

[035] FIG. 3 is schematic showing a rear view of a pallet dispenser showing a pathway of movement of a pusher arm of the pallet dispenser, according to one aspect of the invention.

[036] FIG. 4 is an schematic showing a isometric view of a pusher assembly of a palletizer according to one aspect of the present invention.

[037] FIG. 5 is a schematic showing a front view of the pusher assembly of FIG. 4.

[038] FIG. 6 is a pictorial representation showing an isometric view of a motion assembly of a pallet dispenser according to an aspect of the present invention.

[039] FIG. 7 is a schematic of a cross-sectional view of the motion assembly of FIG. 6.

[040] FIG. 8 is a schematic showing an end view of motion and output shafts of the motion assembly of FIGs. 6 and 7.

[041] FIG. 9 is a schematic showing an end view of a motion bar of the motion assembly of FIG. 6.

[042] FIG. 10 is a schematic showing an isometric view of a pallet dispenser according to one aspect of the present invention.

[043] FIG. 11 is a block diagram of a controller and sensor assembly used with a pallet dispenser according to one aspect of the present invention.

[044] FIG. 12 is a pictorial representation of a pallet dispenser according to one aspect of the present invention.

[045] FIG. 13 is a pictorial representation of a pusher arm according to one aspect of the present invention.

[046] FIGs. 14-18 are pictorial representations of side views showing a pallet dispenser during operation according to one aspect of the present invention.

[047] FIG. 19 is a schematic of a top view of a pallet dispenser according to one aspect of the present invention.

[048] FIG. 20 is a schematic of a side view of the pallet dispenser of FIG. 19.

### **DESCRIPTION OF THE EMBODIMENTS**

[049] Reference will now be made in detail to exemplary embodiments of the invention, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

[050] The present invention is a pallet dispenser having a pallet magazine and a platform for supporting pallets in the magazine. The pallet dispenser provides pallets to a pallet loading system without requiring expensive equipment to vertically separate the stack of pallets by raising or suspending the stack of pallets off of the lowermost pallet. Instead, the present invention may use a cantilever pusher system to push the lowermost pallet from the stack of pallets in the dispenser. Further, the present invention does not need to rely upon pallets having uniform dimensions because the pallet dispenser does not include elements that are dependent upon the size of the pallets, such as forks or other restraining systems that grip or extend into the pallets.

[051] Finally, the present invention may include a cantilever or side-mounted pushing system. Accordingly, the pallet dispenser of the present invention may lie low on the ground, making it more accessible than previous pallet dispensers, that have mechanisms located below the stack of pallets. Accordingly, an operator may more easily load the pallets, and ultimately, may be able to load a higher number of pallets into the dispenser, improving efficiency.

[052] The present invention may also include a motion assembly for providing motion to pallets in the magazine to reduce the frictional forces between the lowermost pallet and the pallet immediately above it. For example, during dispensing, the lowermost pallet rubs against the pallet directly on top of it, as it is pushed from the pallet magazine. Because pallets are frequently reused, the pallets may have damaged boards or other anomalies, including nails or warped deck boards that cause the lowermost pallet to catch on the pallet directly above it, or vice versa. Some embodiments of the present invention may enable the pallets to “hop” over irregularities on adjacent pallets.

[053] According to one aspect of the present invention, a pallet dispenser is provided to supply pallets to a load building and wrapping system. As shown in FIG. 1, a load building and wrapping system 100 may include a pallet conveyer 115 for transporting pallets between the pallet dispenser and a load building device, such as a palletizer 120. The palletizer 120 may be used to load product or packages onto an empty pallet and could be any palletizer known in the art.

[054] The load building and wrapping system 100 may also include a packaging material dispenser 130. The packaging material dispenser may be

associated with the palletizer 120 forming a single unit, or may be separate from the palletizer 120. As embodied herein, and shown in FIG. 1, the packaging material dispenser 130 includes a mast, on which a dispensing component may move. The packaging material dispenser 130 dispenses a sheet of packaging material in a web form, such as stretch-wrap packaging material. Various other packaging materials, generally not considered to be stretch wrap materials, such as netting, strapping, banding, and tape, can be used as well. The packaging material dispenser 130 may be any standard packaging material dispenser known in the art.

[055] The load building and wrapping system 100 may also include means for providing relative rotation between the dispenser and the load to wrap packaging material around the sides of the load. As embodied herein, and shown in FIG. 1, the means for providing relative rotation may include a rotatable turntable 135. Alternatively a wrapping arm or ring to rotate the dispenser around the load may be provided.

[056] The pallet conveyer 115 may include either driven or non-driven rollers for advancing the pallet from the palletizer 120 to a load wrapping area, which may include the packaging material dispenser 130 and turntable 135. Alternatively, the pallet conveyer 115 may use drag chains, belts, transfer ball bearings, or other powered or non-powered low friction elements, including a smooth surface.

[057] As shown in FIGs. 1 and 2, a pallet dispenser 200 for holding empty pallets is provided. The pallet dispenser 200 may include a rectangular pallet magazine 201, a platform 214 below the pallet magazine, and a pusher assembly 230 for pushing a pallet from the magazine 201. The pallet dispenser 200 may

include a front dispensing end 202 facing the palletizer 120, and a rear end 203 opposite the dispensing end 202. The pallet dispenser 200 shown in FIG. 1 includes a stack of pallets 152 in the dispenser 200. A lowermost pallet 150 of the stack of pallets 152 is in a position to be dispensed from the pallet dispenser 200.

[058] Although the invention is described as a pallet dispenser for dispensing a lowermost pallet from the pallet stack, the pallet dispenser also could be configured to dispense any lower pallet from the stack. A lower pallet is any pallet having another pallet above it. In this application, wherever the term "lowermost" is used, it is intended to include the bottom pallet of a stack, in addition to a lower pallet that may not be the lowermost pallet, but that has another pallet above it. For example, in one embodiment, the pallet dispenser may be configured to dispense a second lowermost pallet from the pallet stack.

[059] The pallet dispenser 200 may include a footing bar 206 that provides a stable framework for supporting the magazine 201 and the platform 214. Vertical support bars 205 may extend from the footing bar 206 to the magazine 201 to provide rigid support to the pallet magazine 201. In one embodiment, the vertical support bars 205 and the footing bar 206 are steel bars. However, the vertical support bars 205 and the footing bar 206 could be formed of other materials rigid enough to support and hold the pallet magazine 201 above the platform 214. The vertical support bars 205 may be welded, bolted, or otherwise attached to the footing bar 206.

[060] As embodied herein, and shown in FIGs. 1 and 2, the pallet magazine 201 may include four walls or sides 204, including adjustable horizontal

support bars 207 that may extend around three of the sides 204. In the exemplary embodiment shown, the pallet magazine 201 is a cantilevered magazine, meaning that at least one side of the magazine is not supported from below. Instead, in this embodiment, the cantilevered side is suspended by the adjustable horizontal support bars 207, which provide support to, and suspend the cantilevered pallet magazine 201. The adjustable horizontal support bars 207 may be supported on a non-cantilever side by the vertical support bars 205. The adjustable horizontal support bars 207 may be formed of steel, or other material rigid enough support the cantilevered magazine without significant deformation.

[061] In the exemplary embodiment shown in FIGs. 1 and 2, the adjustable horizontal support bars 207 are located on three sides of the pallet magazine 201. A loading side does not have the adjustable horizontal support bars 207 and may be used to fill the pallet magazine 201 with pallets 152. Because an adjustable horizontal support bar 207 does not extend across the loading side, a fork lift may be used to place a stack of pallets in the magazine. However, it should be noted that the horizontal support bars 207 could be on two sides, or all four sides of the pallet magazine 201.

[062] The adjustable horizontal support bars 207 may be nested rails having a number of holes 214 formed within the rails. The nested rails may be configured to slide relative to each other and bolts may be inserted in the holes to secure the adjustable horizontal support bars at a desired length. Accordingly, although not required, the size of the interior of the pallet magazine 201 may be adjusted to make the magazine larger or smaller. Other methods of adjusting the

size of the interior of the pallet magazine may be used, as would be apparent to one skilled in the art.

[063] The pallet magazine 201 may include corner panels at each corner of the magazine 201. The corner panels, along with the adjustable horizontal support bars 207, define the walls 204 and the interior of the pallet magazine 201. The corner panels may include cantilever corner panels 208 and non-cantilever corner panels 210. The cantilever corner panels 208 may be located on a side of the magazine 201 adjacent the pusher assembly 230 and are suspended in the air by the adjustable horizontal support bars 207. As such, the cantilever corner panels 208 are not supported from below by the vertical support bars 205. The cantilever corner panels 208 are suspended at a height that allows the pusher assembly 230, located at the side of the magazine 201, to push a pallet out from below the pallet magazine 201. The cantilever corner panels 208 may be welded, screwed, bolted or otherwise fixed to the adjustable horizontal support bars 207.

[064] The non-cantilever corner panels 210 may be located on the corners of the pallet dispenser 200 having the vertical support bars 205. They may extend from the footing bar 206 vertically upward, and provide additional support to the horizontal support bars 207. Accordingly, these need not be suspended in the air, but may be supported by either the footing bar 206, or the vertical support bars 205. The corner panels 210 provide rigidity to the interior of the pallet magazine 201, and may be formed of steel, or other material, as would be apparent to one skilled in the art.



[065] In the embodiment shown, the corner panels 208 and 210 cover only the corners of the pallet magazine 201, rather than the sides 204, so that spaces are provided between each corner panel. The spaces allow the corner panels 208 and 210 to be moved close together by adjusting length of the adjustable horizontal support bars 207, to define a small pallet magazine, without overlapping of the corner panels. Likewise, the corner panels may be moved further apart by extending the adjustable horizontal support bars 207. Additionally, the spaces enable an operator to easily view the stack of pallets in the magazine to determine whether the pallet magazine should be refilled with empty pallets.

[066] Due to its cantilevered structure, the pallet magazine 201 includes a front gap 240 and a rear gap 242 formed below the cantilever corner panels 208. The rear gap 242 is sized to allow a pushing element of the pusher assembly 230 to enter into and travel through the pallet magazine 201. The front gap 240 is sized to allow the lowermost pallet 150 from the stack of pallets 152 and the pushing element to pass out of the magazine 201. The corner panels 208 and 210 along the front gap 240 are positioned to restrain all the pallets in the stack except the lowermost pallet. Accordingly, the lowermost pallet is stripped out from underneath the stack of pallets. The front and rear gaps could be gaps within the range of about 4-7 inches, but could also be gaps having other dimensions.

[067] In the exemplary embodiment shown in FIGs. 1 and 2, the corner panels 208 and 210 include flanged tops 212. The flanged tops 212 extend from the top edges of the corner panels 208 and 210, and allow a user or operator to easily

place empty pallets into the pallet magazine 201 through the top. The flanged tops 212 align and guide the empty pallets into the pallet magazine 201.

[068] The pallet dispenser 200 may include a platform 214 for supporting a stack of pallets, such as stack of pallets 152. The platform 214 may be positioned below the magazine 201 and may include floor panels 216. As shown in FIG. 2, the platform 214 may include two floor panels 216. Alternatively, the platform 214 may have one panel, or more than two panels. The floor panels 216 are preferably smooth metal plates, allowing a pallet to slide on the panels with a low amount of friction. Alternatively, the floor panel 216 may include (or comprise) non-driven rollers or driven rollers (or other elements of suitable material) as would be apparent to one skilled in the art.

[069] As shown in FIG. 2, a motion bar 218 extends between the floor panels 216, and may form a part of the platform 214. The motion bar 218 may operate with the floor panels 216 to support a stack of pallets within the pallet magazine 201. Although only one motion bar 218 is shown in the platform 214, additional motion bars may be used. Furthermore, the size of the motion bar may be increased or decreased, or the whole platform 214 may be the motion bar 218.

[070] Threaded bars 220 are associated with the platform 214 to provide height and balance to the platform 214. Each floor panel 216 of the platform 214 may be associated with at least one of the threaded bars 220, which may be rotated to adjust the height of the platform 214 relative to the footing bar 206. The threaded bars 220 may be turned to raise or lower the platform 214 and to level or to slant the platform 214 as desired.

[071] The pusher assembly 230 may operate to provide the necessary force to dispense a pallet from the pallet dispenser 200. It may include a pusher arm 232, a pusher leg 234, and a pusher carrier 236. The pusher assembly 230 may be driven along a pusher guide 238, to push the pallet from the dispenser 200.

[072] FIG. 3 is a rear view of the pallet dispenser 200. As shown, the pusher arm 232 may be raised from a substantially horizontal position or a dispensing position 260 to a substantially vertical position or a resetting position 262. When in the resetting position, the pusher arm 232 is returned from the front dispensing end 202 of the pallet dispenser 200 to the rear end 203 after dispensing a pallet, such as the lowermost pallet 150 of FIG. 1. It should be noted that the resetting position 262 need not be vertical, but need only be a position that allows the pusher arm to move past the pallet magazine 201. Likewise, the dispensing position 260 need not be horizontal, but could be any position that allows the pusher arm 232 to contact and move the lowermost pallet 150 from the pallet magazine 201.

[073] In operation, the pusher arm 232 pushes a lowermost pallet 150 from the pallet magazine 201. The pusher arm 232 is set at a height such that it pushes only the lowermost pallet 150 from the stack 152. In the dispensing position 260, it travels beneath the cantilever corner panels 208 through the front and rear gaps 240 and 242 to dispense the lowermost pallet 150 from the stack of pallets 152. The remainder of the stack of pallets may be maintained within the pallet magazine 201 by the walls of the cantilever corner panels 208 and/or the non-cantilever corner panels 210.

[074] After pushing the lowermost pallet 150 from the stack 152, the pusher arm 232 may be rotated about a pivot from the dispensing position 260 to the resetting position 262. In the resetting position 262, the pusher arm 232 may be moved from the front of the pallet magazine 202 to the rear of the pallet magazine 201. Once the pusher arm 232 arrives at the rear of the pallet magazine 201, it may be lowered from the resetting position 262 to the dispensing position 260. At that time, it may be in the "home position," i.e., a position to dispense another pallet from the pallet magazine 201.

[075] FIGs. 4 and 5 show an isometric view and a side view of the pusher assembly 230 for moving the pallet between the pallet magazine 201 and a load building surface of the palletizer 120. As stated above, the pusher assembly 230 includes the pusher arm 232, and a pusher carrier 236 that rides on a pusher guide 238. In the exemplary embodiment shown, the pusher arm 232 is a rotating bar mounted to a linear bearing, and may be driven along the pusher guide 238. The pusher assembly 230 may be the pusher assembly disclosed in U.S. Application No. 09/985,156, filed November 1, 2001, and titled "Method and Apparatus for Wrapping a Load," the entire disclosure of which is incorporated in its entirety herein by reference.

[076] A motor 246 with an integrated gear box may be attached to the pusher carrier 236 to drive the pusher arm 232 along the pusher guide 238. In such an embodiment, the motor 246 drives rotation of the pusher arm 232 about an axis determined by the pusher carrier 236. Thus, the pusher arm 232 may be moveable between the resetting position 262 and the dispensing position 260.

[077] As shown in FIGs. 4 and 5, the pusher arm 232 and the pusher leg 234 form an "L" shape. The pusher leg 234 may be disposed upon the pusher carrier 236. The pusher guide 238 may form a track for the pusher carrier 236 which carries and moves the pusher arm 232. The pusher arm 232 may be made of any material of sufficient strength and rigidity to move pallets from the magazine, and could be, for example, steel.

[078] The pallet dispenser of the present invention does not use expensive equipment to raise or lift the stack of pallets from the lowermost pallet. Instead, the present invention uses a cantilever pusher system 230 to push the lowermost pallet from the stack of pallets. During dispensing, the lowermost pallet rubs against the pallet directly on top of it, as it is pushed from the pallet magazine 201. Because pallets are frequently reused, some may have slight damage. This may cause the lowermost pallet to catch on the pallet directly above it, or vice versa. In order to reduce the chance of the pallets catching on each other, or alternatively, to release the pallets from each other, a motion assembly may be provided with the pallet dispenser 200 to reduce the friction forces upon the lowermost pallet and enable the pallets to hop over irregularities on adjacent pallets.

[079] FIGs. 6-9 show one embodiment of a motion assembly 270. It may be associated with the motion bar 218 of the platform 214, and may be disposed below or adjacent to the platform 214. It may be used to provide motion to a stack of pallets 152 in the pallet magazine 201. This motion may be used to counteract the downward force on the lowermost pallet from the vertical stack of pallets 152 by providing motion, such as, for example, vibration, to the stack 152 to float the stack

152 above the lowermost pallet 150. Accordingly, the friction between the lowermost pallet 150 and the pallet above it is reduced. Furthermore, the friction between the bottom or sides of the lowermost pallet 150 and the pallet dispenser 200 is also reduced. The motion may be any motion that will reduce the force from the stack on the lowermost pallet including, for example, a vibratory motion or a slower, oscillating motion.

[080] The motion assembly 270 may be associated with the motion bar 218, which preferably forms a part of the platform 214. As shown in FIGs. 6-9, it may include a motion motor 272, a motion shaft 276, and pillow bearings 280 located at one end of the motion bar 218. It may include a motion linkage 288 at the other end of the motion bar 218.

[081] FIG. 6 shows the motor 272. It could be any standard motor known in the art. In one embodiment, the motor 272 is a variable speed DC motor manufactured by Baldor. It may include an output shaft 274 that may be eccentrically associated with the motion shaft 276. As the motor 272 turns the output shaft 274, the motion shaft 276 eccentrically rotates, providing cyclic motion to the motion bar 218. In the embodiments shown, the output shaft extends through a platform support 278 on the underside of the platform 214. It provides stability to the motor 272 as it operates.

[082] In another embodiment, the motion assembly 270 could include a cam to raise or lower the motion bar 128, or alternatively, to directly contact the lowermost pallet 150. In another embodiment, a hydraulic or pneumatic cylinder is included for providing motion to the motion bar 218. Other systems for providing

motion to the motion bar or to the pallet stack would be apparent to one skilled in the art.

[083] FIG. 7 is another view of the motion assembly 270. As shown in FIG. 7, the output shaft 274 extends through the motion shaft 276. Pillow bearings 280 may connect the motion shaft 276 to a support bar 282. It, in turn, may be connected to the motion bar 218. As the output shaft rotates, the motion shaft 276 rotates in the pillow bearings 280 causing the motion bar 218 to move up and down in a circular manner or eccentrically. However, for purposes of the invention, the motion bar need not move in a circular manner, but may move in other patterns, such as, for example, only vertically, as would be apparent to one skilled in the art.

[084] The motion bar 218 is placed to rise above the floor panels 216 of the platform 214 to provide motion to the lowermost pallet on the platform 214. Accordingly, as the motion assembly 270 rotates the motion shaft 276, the motion bar 218 moves under and against the stack of pallets in the pallet magazine 201. The platform supports 618, and or additional supports and bearings 284 may be provided to support and to reduce flexing of the output shaft 274. In one embodiment, the motion bar 218 is configured such that roughly two-thirds of the movement of the motion bar occurs below the platform 214 while one-third of the movement of the motion bar 218 occurs above the platform 214.

[085] FIG. 8 shows an end view of the motion shaft 276 and the output shaft 274. The motion shaft 276 and the output shaft 274 are keyed together by a key 286. The axis of the motion shaft 276 may be offset from the axis of the output shaft 274 by about 3/8 of an inch. However, as would be apparent to one skilled in

the art, other offset amounts could be used. By varying the amount of offset, the motor speed, and/or the position of the motor 272, the amount of motion to be transferred to the pallet stack can be adjusted.

[086] In another exemplary aspect, the motion bar 218 could be associated with a hydraulic or pneumatic cylinder to provide the motion to the motion bar 218. In this embodiment, the hydraulic or pneumatic cylinder provides a vertical force against the motion bar 218 to pivot the motion bar 218 about a point, to raise and lower the motion bar 218, or to otherwise provide motion to the motion bar 218. Other systems of providing motion to the motion bar 218 may be used as would be apparent to one skilled in the art.

[087] In the embodiment shown in FIGs. 6-9, the motion assembly 270 is connected to the motion bar 218 toward a dispensing end 202 of the motion bar 218. The dispensing end 202 is the end associated with the dispensing end 202 of the pallet magazine 201. FIG. 9 shows an end view of the motion bar 218 at the rear end 203 of the pallet magazine 201. Because the motion bar 218 may rotate in a circular motion, the rear end of the motion bar 218 includes the motion linkage 288 to accommodate this motion. The motion linkage 288 may include a bearing system having a bar bearing 290 and a support bearing 294, connected to each other by spanning bars 292. The support bearing 294 is attached to a fixed portion of the pallet dispenser 200.

[088] In one embodiment, the motion assembly 270 is associated with the motion bar 218 such that each end of the motion bar simultaneously moves or vibrates, or alternatively, vibrates in an offset sinusoidal manner. In this



embodiment, the output shaft of the motor could be located centrally under the motion bar, and bearing systems could be used on both ends. Other systems for displacing or vibrating the whole motion bar 218 could be used, as would be apparent to one skilled in the art.

[089] Further, in one embodiment, the motion bar 218 is a single floor panel comprising the whole platform 214, as shown in FIG. 10. Accordingly, in this embodiment, the whole platform provides motion to move or vibrate the stack of pallets 152. In another embodiment, the platform includes two or more motion bars that may together move or vibrate the pallet stack.

[090] FIG. 11 is a block diagram showing a control system 296 for the motion assembly 270 that may be used in the pallet dispenser 200. It includes a sensor 298 and a controller 300. It may be associated with the motion motor 272 of the motion assembly 270. The control system 296 may be used to activate, alter, or deactivate the motion assembly 270 when the system determines that the lowermost pallet is jammed or caught on the pallet above it. The sensor may be associated with the pusher assembly 230, and may be configured to detect when the load on the pusher arm 232 exceeds a preset limit. The preset limit may be set to indicate that the lowermost pallet has caught on the stack of pallets during dispensing.

[091] In one embodiment, the sensor 298 sends a signal to the controller 300 which monitors the sensor 298. When the sensor signal exceeds the preset limit, the controller 300 activates the motion motor 272 to move the motion bar 218, thereby moving the stack of pallets. Accordingly, in this embodiment, the motion assembly 270 does not continuously operate but operates only when the lowermost

pallet is caught on the stack of pallets, as determined by the sensor 298. In another embodiment, when the signal exceeds the preset limit, the controller 300 sends a signal to the motion motor 272 to either increase or decrease the motor speed, in order to change the movement of the motion bar 218. In still another embodiment, the motion assembly 270 is deactivated when a sensor signal exceeds the preset limit, thereby shutting down the dispenser.

[092] The sensor 298 could be, for example, a current sensor associated with the pusher carrier 236 to determine when the current to the pusher carrier 236 exceeds a preset rating, indicating the magnitude of the load against the pusher arm 232. The controller 300 could be any standard controller known in the art. Further, it may be associated with the motor 272 of the motion assembly 270 to activate or deactivate the motor 272 as is known in the art.

[093] In another embodiment, the sensor 298 is a timer for measuring the length of time taken to dispense a pallet from the dispenser 200. In this embodiment, if the pallet is not dispensed, as determined by the position of the pusher arm 232, within a certain time, the controller 300 determines that the pallet must be jammed, and will either shut down or provide a different motion to the pallet.

[094] In another embodiment, the motion assembly 270 may be activated when the pusher arm 232 reaches a set position while passing through the magazine. Likewise, the motion system 270 may be deactivated when the pusher arm 232 reaches a different position either in the magazine or after the pusher arm 232 has passed out of the magazine 201. Alternatively, the motion system 270 may

include a timer that is activated at a preset position in the dispensing process for a given time in the process.

[095] FIGs. 12 and 13 show an another embodiment of the pallet dispenser 200. In this embodiment, the pallet dispenser 200 includes a roller platform 310 and a pusher arm 332 having a pusher arm body 312, an optional pusher roller 314, and a wheel 316.

[096] The roller platform 310 may include either driven or non-driven rollers 311. In one embodiment, the complete platform is formed of rollers 311. In another embodiment, the roller platform 310 is formed of relatively narrow strips of rollers that may be included on each side of the pallet magazine 201 to support the sides of a lowermost pallet in the magazine 201. In the embodiment shown, the roller platform 310 includes roller conveyers at each side of the magazine 201. Other configurations could be included as would be apparent to one skilled in the art.

[097] In FIGs. 12 and 13, the pusher arm 332 is in the dispensing position 260, at the rear end 203 of the pallet magazine 201. The pusher arm 332 operates in substantially the same manner as described above, pushing a lowermost pallet from the magazine through a gap between the roller platform 310 and the magazine walls 204. In this embodiment, the pusher arm body 312 of the pusher arm 332 includes a taper surface 318, a pushing surface 320, and a flat surface 322. The pushing surface 320 is configured to face into the magazine 201, and is configured to directly contact a pallet in the magazine 201. In this embodiment, the pushing surface 320 is a flat, substantially vertical surface. Other surface configurations could be used as would be apparent to one skilled in the art. The flat surface 322

may extend substantially horizontal to the pallet magazine 201, and together with the pushing surface 320, may form an edge 324. In one embodiment, the edge 324, as well as the flat surface 322 may be configured to have a height that is substantially equal to or lower than the top of the lowermost pallet. Accordingly, any pallet on the lowermost pallet would extend above the flat surface 322 when the pusher arm 332 is pushing the lowermost pallet from a stack of pallets.

[098] The taper surface 318 may be formed adjacent to the flat surface 320, and may extend at an angle from the flat surface 320. In one embodiment, the taper surface 318 is angled between 15 and 40 degrees. In one embodiment, the taper surface 318 may be configured to extend to a height that is higher than the top edge of the lowermost pallet. It may operate as one side of wedge to push a pallet on the lowermost pallet up as the pusher arm 332 moves through the pallet magazine 201.

[099] In the embodiment shown in FIGs. 12 and 13, the pusher roller 314 may be attached at the top of the taper surface 318. It may be attached to each end of the pusher bar 332, and may be configured to turn as the pusher bar 332 moves below the pallet stack when pushing a lowermost pallet. The height of the pusher roller 314 may be configured to be higher than the top of the lowermost pallet, thereby coming into contact with the pallet above the lowermost pallet, and possibly raising the platform above the lowermost pallet, as the pusher arm 332 moves through the pallet magazine 201.

[0100] The wheel 316 may be attached to the end of the pusher arm 332. Accordingly, in the embodiment shown, the weight of the pusher arm 332 may be

supported at both ends. The wheel 316 may be raised and lowered into the dispensing position and the resetting position with the pusher arm 332. The wheel 316 may be formed of any material, but in this embodiment, along with the pusher arm 332, it is preferably a relatively light material, enabling the pusher arm 332 to be easily moved from the dispensing position 260 to the resetting position 262.

[0101] The pallet dispenser 200 may also include a track 326 extending through the pallet magazine 201. The track 326 may be any surface sufficient to support the weight of the pusher arm 332 and any weight supported by the pusher arm 332. In the embodiments where the roller platform 310 includes a floor panel, the panel may provide the support for the wheel 316, obviating any need for the separate track 326.

[0102] The pusher arm 332 may reduce the friction between the lowermost pallet and the pallet above it by separating the upper pallet from the lowermost pallet. In one example, when the pusher bar 332 pushes a lowermost pallet from the magazine 201, the taper surface 318 contacts the pallet directly above the lowermost pallet. As the pusher bar 332 continues to advance through the magazine 201, the taper surface 318 may force the pallet stack upward so that the pusher arm 332 may partially support the weight of the pallet stack. As the pusher arm 332 moves further into the pallet magazine 201, the weight of the pallet stack continues to transfer from the lowermost pallet to the pusher arm 332. The wheel 316 on the track 326 becomes a support for the pusher arm 332. As the weight of the pallet stack becomes supported by the pusher arm 332, the weight is taken off the lowermost stack, providing less friction, and reducing the chance of interference

with nails or other anomalies on the pallets. Further, the lowermost pallet may roll on the roller platform 310, further reducing friction between the lowermost pallet and the platform.

[0103] If the pusher roller 314 is higher than the top of the taper surface 318, the top of the taper surface 318 may not need to be higher than the edge of the lowermost pallet because the pusher roller 314, rather than the taper surface 318, may provide the lift and contact with the pallet stack. Alternatively, the pusher arm 332 may include a pusher surface and a tapered surface. Accordingly, there is no flat surface. In another alternative, the pusher arm 332 may not include a taper surface, and be formed only of a pusher roller 314 that is configured to support the weight of the pallet stack when the lowermost pallet is being pushed.

[0104] As shown in FIG. 12 and 13, the pusher arm 332 may be driven by the pusher carrier 236 at one side. The wheel 316 may be a non-driven wheel, and may serve to support the weight of the pallet stack. Although the pusher bar 332 is supported and driven at one side by the pusher carrier 236, in this embodiment, the pusher arm 332 is not a cantilever arm, and therefore need not be used on a cantilever type system. In one embodiment, the pusher arm 332 with the taper surface may be used in conjunction with the motion assembly 270 described above.

[0105] According to one aspect of the invention, a method for dispensing a pallet from a pallet dispenser is provided. As shown in FIG. 14, a lowermost pallet 150 of a pallet stack 152 is provided in the pallet magazine 201. In FIGs. 14-18, the pallet stack 152 is a single pallet stacked upon the lowermost pallet 150. However, the pallet stack 152 could include any number of additional pallets. As shown in

FIG. 14, the pusher arm 232 is disposed at the rear of the pallet magazine 201 in the dispensing position 260.

[0106] In operation, the pusher arm 232 enters the pallet magazine 201 through the rear gap 242 and contacts the lowermost pallet 150. As explained above with reference to FIGs. 4 and 5, the pusher arm 232 may be moved by the pusher carrier 236 along the pusher guide 238. The lowermost pallet 150 is pushed by the pusher arm 232 through the front gap 240 of the pallet magazine 201, as shown in FIG. 15. The corner panels 208 and 210 restrain the stack of pallets 152 from moving with the lowermost pallet 150, holding the stack within the pallet magazine.

[0107] FIG. 16 shows the lowermost pallet 150 traveling out of the front gap 240 of the pallet magazine 201. FIG. 17 shows the lowermost pallet 150 completely dispensed from the pallet magazine 201. In this embodiment, the lowermost pallet 150 is pushed onto the pallet conveyer 115 for loading by a palletizer. The stack of pallets 152 drops down, and the next pallet on the stack is now in the lowermost position in the pallet magazine 201.

[0108] As shown in FIG. 18, the pusher arm 232 is then raised from the dispensing position 260 to the resetting position 262. Once the pusher arm 232 is raised to the resetting position, the pusher carrier 236 is moved along the pusher guide 238 from the dispensing end 202 of the pallet magazine 201 to the rear end 203 of the pallet magazine 201. At that location, the pusher arm 232 is rotated from the resetting position 262 to the dispensing position 260, and is ready for additional dispensing.

[0109] The pallet 150 may now be in a loading position for loading by a palletizer, such as the palletizer 120 described with reference to FIG. 1. The palletizer could load the pallet 150 using standard methods known in the art. The loaded pallet could then be wrapped with packaging material using a packaging material dispenser, such as the packaging material dispenser 130 described with reference to FIG. 1.

[0110] FIG. 19 is a top view of another exemplary embodiment of the pallet dispenser 200. The pallet dispenser 200 is adjacent to a turntable 135. A packaging material dispenser (not shown) or palletizer (not shown) may also be provided. In this embodiment, the pallet dispenser 200 includes a pusher assembly 230 having a dispenser pusher arm 232 and a turntable pusher arm 350. The pusher assembly 230 pushes a lowermost pallet 150 from the pallet dispenser 200 to the turntable 135. Simultaneously, the turntable pusher arm 350 pushes a loaded palletized load 362 from the turntable 135 to a load storage or pickup station 364. In this embodiment, the dispenser pusher arm 232 and the turntable pusher arm 350 operate in tandem along a common pusher carrier 236 on a common pusher guide 238. Accordingly, when the pusher arms 232 and 350 are raised from a dispensing position 260 to a resetting position 262, they move in concert.

[0111] In one embodiment, the distance from the turntable 135 to the load pickup station 364 is further than the distance from the pallet dispenser 200 to the turntable 135. In this embodiment, two pusher carriers are provided, one for each pusher arm.



[0112] FIG. 20 shows a side view of the pallet dispensing system of FIG. 19. In FIG. 20, the dispenser pusher arm 232 moves through the pallet magazine 201 to push the lowermost pallet 150 to the turntable 135 for loading. Simultaneously, a palletized load 362 is moved from the turntable 135 to the load pickup station 364 by the turntable pusher arm 350. Once on the turntable, a load is built on the pallet. Subsequently, relative rotation is provided between the dispenser (not shown) and the palletized load to wrap packaging material around the sides of the load.

[0113] Other embodiments of the invention will be apparent to those skilled in the art from consideration of the specification and practice of the invention disclosed herein. It is intended that the specification and examples be considered as exemplary only, with a true scope and spirit of the invention being indicated by the following claims.